Guidance Document

Preparing Water Shortage Response Plans

June 2005

DOH PUB. #331-301 (Rev.)

Guidance Document

Preparing Water Shortage Response Plans

June 2005

DOH PUB. #331-301 (Rev.)

For more information or additional copies of this publication, call (800) 521-0323 or contact:

Training and Outreach Section
Office of Drinking Water
Department of Health
PO Box 47828
Olympia, WA 98504-7828

Acknowledgements

We extend our appreciation to everyone who contributed to the concepts and information included in these guidelines. Special thanks to the California Department of Water Resources' Office of Water Conservation for its excellent series of Water Conservation Guidebooks, and to the American Water Works Association.

To produce these "Guidelines," we relied in particular upon two invaluable sources of information: California's "Urban Drought Guidebook" (March 1988), authored by Jean Colthurt and William O. Maddaus of Brown and Caldwell Consulting Engineers, Pleasant Hill, California, and the American Water Works Association's "Water Conservation" (1987), also authored by William O. Maddaus.

Contents

Contents - Continued

Overview: Water Shortage Response Planning

Introduction

The purpose of this document is to help utilities develop short-term water shortage response plans. Water system planning, as required by WAC 246-290-100, provides the framework for making key water supply management decisions. In 1982, the Drinking Water Section of the Department of Social and Health Services* elaborated on this planning process by developing an Emergency Planning Instructional Guide. This guide helps utilities develop plans to minimize the impacts of emergencies such as landslides, windstorms, fires, severe cold, civil disorder, etc. However, further guidance on how to prevent and plan for water shortages caused by drought is necessary because periodic droughts lead to occasional water shortages.

*This section of the Department of Social and Health Services is now the Office of Drinking Water within the Environmental Health Division of the state Department of Health (DOH).

Causes of Water Shortage

A water shortage can be any situation in which water supply is inadequate to meet demand. Causes of water shortages are:

- Drought
- Water contamination
- Inadequate planning to meet demand
- Shallow wells
- Inadequate pumping equipment
- Water waste
- Water outage due to loss of power or major service disruption

The frequency or cause of a water shortage may indicate the best way to overcome it. Droughts are temporary, but often recur. Thus, depending upon drought frequency, a solution to the problems created by drought may be reducing demand or augmenting supply.

For example, water contamination can put a water supply out of commission permanently (or at least until treatment technology becomes affordable). In this case, a new source of supply maybe warranted. To eliminate a water shortage caused by inadequate planning or equipment, consideration to design and capital improvements is necessary. To eliminate shortages resulting solely from increased demand for water resources, long-term resource management is required.

Conservation

While there is no universally accepted definition of water conservation, this term is often used to mean "saving water" through efficient or wise use. People do not always agree on the meaning of "efficiency" because there are varying degrees of efficiency. For example, efficient residential water use can range from reducing toilet tank flows and turning the tap off when water is not in use (activities that do not require significant, if any, lifestyle changes), to planting low-water-use landscapes and car washing restrictions (activities that do require environmental or lifestyle changes).

In terms of utility management activities for dealing with water shortages, conservation can mean both short-term curtailment of demand and long-term resource management.

Short-term curtailment of demand is achievable through a vigorous public information program, which can include both voluntary and enforceable actions. The curtailment is temporary and when a shortage ends, consumers usually resume their former water use habits.

Long-term resource management involves efficient water use and resource-protection strategies designed to effect permanent change in water management and use.

Utilities often initiate activities under normal circumstances to promote efficient use of water. In this document, the term "conservation" refers to these normal activities. In response to an abnormal water shortage, utilities often initiate special actions or programs known as "demand reduction" activities.

Purpose and Objectives

The purpose of these guidelines is to help utilities develop a plan for activities to carry out, and to produce desired results, in a short period.

Water shortage response plans (WSRPs) help utilities:

- Conserve available water supplies to the extent possible.
- Determine whether additional sources of supply should be developed.

To ensure maximum flexibility for utilities preparing a WSRP, both demand reduction and supply augmentation options are presented for consideration. Utilities should select the combination of options most appropriate for them.

We believe utilities will achieve several benefits by following the process described in these guidelines. First, a structured planning process simplifies decision making by making it more systematic. Second, utilities will become more familiar with principles of water resource management – a skill that will become increasingly useful over time. Third, the process yields a written plan, which helps to ensure all alternatives are considered and analyzed, and provides a record that may be reviewed by other interested parties.

These guidelines also enhance DOH's public policy goals by encouraging utilities to start developing resource management policies and to record and monitor demand and supply, if they are not already doing so. DOH's overall objective is to encourage utilities to improve their resource management capabilities and eliminate water waste wherever possible.

Preparation of a plan is strongly encouraged, but not required. The amount of time needed to prepare a WSRP depends on how much information a utility has at the outset, and upon the complexity of the water system.

Relationship to Water System Plans

If you have developed a water system plan, you are aware of the resource management and conservation elements that must be included. Traditionally, utilities had to find their own ways to address these elements. Now these guidelines provide more direction on how to address resource management and conservation. A utility's WSRP can, therefore, stand-alone or be incorporated into a water system plan.

If you have a current water system plan, you already have a lot of the information required in a WSRP. For example, you can transfer utility policies, and demand and supply data developed, summarized and documented in your water system plan to your WSRP.

Organization

The process described herein covers three steps (Figure 1):

Step 1: Problem Assessment

This step requires you to:

a. Assess your demand and supply situation.
b. Determine if you are likely to have a water shortage.

Step 2: Options for Dealing with a Water Shortage

This step requires you to:

a. Develop and clarify utility policies regarding ways to address potential water shortages.
b. Consider a wide range of options for dealing with a water shortage (including demand reduction and supply augmentation options).
c. Evaluate and select a course of action that is consistent with your utility policies.

Step 3: Plan Implementation

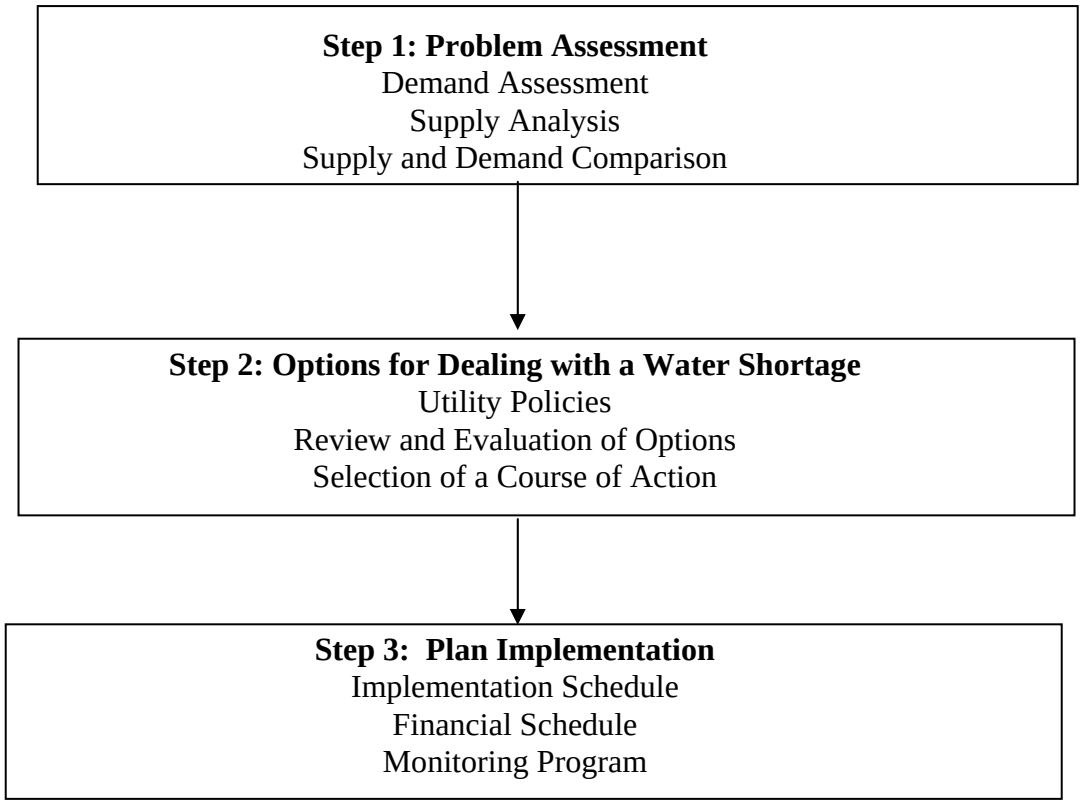
This step requires you to:

a. Establish a schedule for implementation of your program.
b. Determine the total cost of your program, and how the utility will pay for it.
c. Monitor the effectiveness of your program.

Each step is comprised of two parts. The first part, "Objective," provides background information and describes the overall intent of the step. The second part, "Plan Content," explains how to develop the information required in each step.

Work sheets have been provided to assist utilities in developing their plans. Plans can be prepared directly by utility managers and operators, or by consultants in close cooperation with utility managers and operators.

Figure 1: Water Shortage Management Plan Flow Chart



Review

If you prepare a WSRP as a contingency plan, you may send it to your DOH Regional Office for review. If you are currently preparing a water system plan, you should include your WSRP as a part of the plan.

In either case, DOH will review each WSRP submitted to ensure:

- The water system has developed a practical, realistic action plan to respond to water shortage conditions.
- The WSRP identifies appropriate demand reduction and/or supply augmentation options the system can implement realistically.
- The WSRP is consistent with the utility's water system plan (if one exists).

Public Information

Utilities facing a potential water shortage should be prepared to keep the public informed on a regular basis about the water supply situation and their efforts to ensure a shortage does not occur. The public will appreciate knowing of their water utility's efforts to maintain a safe, adequate water supply. If putting a WSRP into action, publicize its requirements well in advance so customers know what to expect ahead of time.

A public information program keeps your customers informed and provides an opportunity for you to ask for their cooperation. For example, a well thought-out campaign that asks customers to adopt (voluntary) conservation measures can save up to 10 percent of normal water demand. To ensure success, however, it is important not to underplay or magnify a shortage, as public confidence in a water utility can be eroded by inaccurate information. It is also important to work closely with the media to ensure information is reported accurately. Carefully worded news releases are an effective way to get your message out.

Further Information

These guidelines are intended to assist utilities in developing water shortage response plans. They provide a framework for utilities to think about water shortage, demand reduction, resource management, utility policies, public information and financing. While a broad spectrum of topics is covered, in-depth information on how to undertake particular aspects of demand reduction or supply augmentation programs is not provided.

For information on how to develop and carry out particular programs, such as a residential "retrofit" program or a leak detection program, call or visit your state library system at (360) 704-5200, the American Water Works Association at (303) 794-7711, or the California Department of Water Resources at (916) 653-5791.

Information is also available online at American Water Works Association: http://www.awwa.org/ or at California Department of Water Resources: http://wwwdwr.water.ca.gov/

Step One: Problem Assessment

Objective

A comparison of projected supply and demand indicates whether a utility faces a potential water shortage. Ideally, a utility should know not only whether it is likely to have a shortage, but how much of a shortage. This would enable the development of responses based on the projected magnitude of an impending shortage. In reality, it is very difficult to estimate the projected magnitude of a shortage because of the difficulty involved in estimating available supplies. Therefore, the primary objective of this step is to determine whether a utility faces the possibility of a shortage. The secondary objective is to determine, if possible, the magnitude of this potential shortage.

To determine whether your utility is likely to face a water supply deficit accurately, analyze both past and present supply and consumption information. Source and service meters present the best way of measuring supply and demand, and provide other benefits as well.

Meters

Metering is an appropriate water supply management tool whether or not a utility faces a potential water shortage. In terms of water conservation, data gathered in 1980, 1981, and 1982 shows that metered households use an average of 20 percent less water than un-metered households[1]. Although meters represent an initial capital outlay, they make water system management more systematic and professional.

Source and service meters enable utilities to:

- Account for their water
- Charge rates based on the amount of water consumed (such as uniform or inclining block rates)
- Detect leaks
- Save money (through the elimination of lost pumping costs and lost revenues)
- Save water

DOH supports statewide metering of sources and services.

[1] Maddaus, William 0., Water Conservation, Denver: American Water Works Association (1987), p. 63.

Plan Content

A. Demand Analysis

Measuring Consumption

Most larger utilities monitor their supplies and keep records of consumption and use. Source and service meters enable utilities to record consumption information on a regular basis. While metering presents the best method of measuring consumption, several alternatives are available for utilities without source or service meters:

a. If you have an "elapsed time" meter on your well pump, and you know the pumping capacity of your well at a given pressure, you can determine how much water is consumed over a given period. Calculate back one year and determine your total annual consumption.
b. If you have a storage reservoir, you can shut down the pumps and determine how much consumption you have in a 24-hour period by the amount of reservoir drawdown you have in the same period. Record the reservoir level before shutting down the pumps and then again after 24-hours. Then turn the pumps back on. Do this once a week for two or three weeks and average the results. It is important to remember that without sufficient water storage, you may increase the risk of not having adequate fire-flow. Therefore, it is best to perform this exercise when the risk of fire is low. These risks are the same, however, as the risks undertaken when emptying storage tanks to clean or repair them.
c. A third way to estimate water consumption is to calculate Average Day Demand (ADD) per household or Equivalent Residential Unit (ERU) and multiply that figure by the number of households or ERUs the system serves. In 1994 – 1995 DOH assessed residential water demands in Washington, (commercial and industrial demands were not specifically addressed). The assessment would be useful for water system designs.

   For single-family residential systems, DOH observed that average annual water demand appears to be related, primarily, to average annual precipitation levels.

   From this assessment, the following equation was developed to determine ADD on a per-residential connection of ERU basis.

   ADD = (8000/AAR) + 200

   Where: **ADD** = Average Day Demand, (gallons-per-day/ERU)

   AAR =Average Annual Rainfall, (inches-per-year)

   Use this equation with rainfall records for the area in which the system is located. When estimating water demands, actual precipitation records for the area should be used.

Precipitation records and locations of the numerous rain gauge stations in Washington are available from the National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC), Climatological Data Annual Summaries and County Extension Offices.

The NCDC may be reached by phone at (828) 271-4800.

NOAA has precipitation data for Washington online at:
http://www.ncdc.noaa.gov/pub/data/coop-precip/washington.txt

The Western Regional Climate Center (WRCC) is recommended for precipitation and temperature data. Call WRCC at (775) 674-7010, fax (775) 674-7016 or visit the website at:
http://www.wrcc.dri.edu/summary/climsmwa.html

The website has a map of all climatic data stations in Washington, and tabular and graphical summaries of historical climatic data available for each station.

For more information on estimating water demand please see the DOH Water System Design Manual (DOH PUB # 331-123, August 2001). It is online at:
http://www.doh.wa.gov/ehp/dw/our_main_pages/public.htm

Water Consumption Factors

a. User Characteristics

Whether metered or not, it is important to identify your customer base by type of user (*i.e.*, agricultural, commercial, industrial or residential). Further breakdown of commercial and industrial users can also be made (*i.e.*, car wash, laundry or paper mill). Each customer type requires different amounts of water.

b. Peak Use

The ADD calculation above does not account for increased seasonal peak use consumption. For system design purposes, DOH uses a peaking factor of 2.0 (ADD x 2.0) to determine maximum day demand. In Washington, peak water consumption occurs from mid-July through the fall when irrigation and outdoor water use are at their highest levels. For shortage response planning, peak water use can be assumed approximately two times non-peak use. It is important to remember that specific conditions, such as large lot size or extreme weather, could warrant the use of a higher peaking factor. Literature and documented experience for various water systems in Washington have provided support for peaking factors in the 1.5 to 3.0 range.

Analysis of past consumption records, or using one of the estimation methods listed above, should enable a utility to determine current consumption.

WORKSHEET 1
Current Water Consumption

Water Demand Factors

a. Growth Demand

Before water demand can be projected, it is important to account for growth that is likely to take place within your service area in the next 12 months. To find out how much growth is expected, refer to city or county land use plans and population projections. Estimate the additional numbers of gallons required for each new residential service and new large user. Add these numbers together to derive total demand. Add this total to last year's total consumption (whether metered or estimated).

b. Drought Factor

Another factor affecting water consumption is prolonged hot, dry weather. Experience shows that utilities facing a drought see an increase of about 5 percent over normal water consumption during the months affected by the drought. If a hot, dry weather pattern settles over your region, you may want to project a 5 percent increase over normal water consumption for the projected duration of the drought. Even if the hot, dry weather does not continue, you will have a realistic "worst case" scenario.

WORKSHEET 2
Water Demand Factors

Water Demand Projections

When projecting future water demand, make sure past and future time periods are equivalent. If projecting demand for one year, use a year's worth of consumption data. If projecting "peak use" demand, use the most recent consumption data for the equivalent time period.

A one-year water demand forecast can be made based upon a utility's current consumption information (Worksheet 1) and any projected growth or dry weather that may occur (Worksheet 2). To project water demand for the next 12 months, or for the projected duration of a water shortage, add current consumption, projected growth demand, and projected "drought factor," if appropriate. This is your projected demand.

WORKSHEET 3
Water Demand Projections

B. Supply Analysis

Once utilities have an estimate of their expected water demand over a given time period, the focus can shift to an evaluation of existing sources and their limitations. Knowing how supply is available allows utilities to compare supply and demand and to project, not only a shortage, but also the extent of the shortage they are likely to have. Knowing the magnitude of a potential shortage gives utilities more precise information upon which to base management decisions. Unfortunately, quantifying or estimating available supply is much more difficult than quantifying or estimating consumption. As a result, utilities may have only a vague idea of how

much water is safely or optimally available for withdrawal from a source. Although prediction of the magnitude of a potential water supply deficit is desirable, it is not always possible given the cost and effort of obtaining such information and current knowledge of aquifer and basin capacities. Therefore, the important thing to determine is whether a utility believes there is a trend toward decreasing supplies in the near future.

1. Water Supply Factors

Natural resource agencies and larger water utilities use various factors as indicators of water supply.

For **surface water**, some of these supply indicators are:

- River and stream inflow projections
- Reservoir and lake levels
- Intake or water extraction levels
- Snow pack
- Evaporation and seepage rates

For **ground water**, some of these supply indicators are:

- Static water levels
- Pumping water levels
- Ground water table elevations
- Aquifer characteristics
- Well depth, construction and pump limitations
- Historical well yield information

These factors have a direct or measurable impact on water supplies. In addition, less direct factors such as water quality, weather forecasts, and adjacent water supplies can provide indications of water availability. If unable to measure your own water supply, request information on the above supply factors from the appropriate agency listed below.

2. Measuring Water Supplies

Because it is highly technical, it is best to let natural resource agencies and other experts measure the volume of available surface or ground water sources. To collect water supply information for your area, contact the following sources:

U.S. Geological Survey (USGS) – has produced a variety of hydrologic maps and reports, including a general aquifer map covering the state of Washington. Aquifer maps for special study areas such as Island County, Bainbridge Island, the San Juan Islands and the Columbia Basin Plateau are also available. For information, contact the Information Officer at:

USGS Water Resources Division
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

Phone: (253) 428-3600 ext 2653
FAX: (253) 428-3614
Web site: **http://wa.water.usgs.gov/**

Washington State Department of Ecology (Ecology) – has broad powers to prevent ground water depletion, including the authority to close an aquifer to further use. For information on ground or surface water availability, call Water Resources Program staff at the:

Northwest Regional Office
Phone: (425) 649-7000
Serving *Island, King, San Juan, Skagit, Snohomish, Kitsap, and Whatcom counties*

Southwest Regional Office
Phone: (360) 407-6300
Serving *Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Pierce, Lewis, Mason, Pacific, Skamania, Thurston, and Wahkiakum counties*

Central Regional Office
Phone: (509) 575-2490
Serving *Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, and Yakima counties*

Eastern Regional Office
Phone: (509) 329-3400
Serving *Adams, Asotin, Columbia, Franklin, Ferry, Garfield, Grant, Lincoln Pend Orielle, Spokane, Stevens, Walla Walla, and Whitman counties*

Washington State Department of Health (DOH) – The Office of Drinking Water (ODW) can provide information on water supply and quality. ODW maintains the state's largest database of utility-provided supply and quality information. For information, contact the:

Eastern Regional Office
Phone: (509) 456-3115
FAX: (509) 456-2997
Serving *Adams, Asotin, Benton, Chelan, Columbia, Douglas, Franklin, Ferry, Garfield, Grant, Kittitas, Klickitat, Lincoln, Okanogan, Pend Orielle, Spokane, Stevens, Walla Walla, Whitman, and Yakima counties*

Northwest Regional Office
Phone: (253) 395-6750
FAX: (253) 395-6760
Serving *Island, King, Pierce, San Juan, Skagit, Snohomish and Whatcom counties*

Southwest Regional Office
Phone: (360) 664-0768
FAX: (360) 664-8058
Serving *Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Kitsap, Lewis, Mason, Pacific, Skamania, Thurston, and Wahkiakum counties*

Well Drillers – Well drillers can provide general information on local ground water conditions. For example, well drillers may be aware of areas in which well water levels have dropped over a period of years – possibly indicating ground water depletion.

Local Health Departments – Your local health department may have additional water supply and quality information.

Consulting Engineers – The information available from universities and natural resource agencies may not always cover the areas of interest to utilities. At the same time, most utilities cannot afford to keep full-time water resource experts on staff. Consulting engineers can provide needed expertise in water resources, engineering and other areas. Consulting firms providing a variety of technical skills can be found throughout Washington.

The U.S. National Weather Service (NWS) – Provides the official weather forecast, up-to-date weather information, and forecasts. For public information from the Seattle office, call (206) 526-6087 or visit the website at: http://www.wrh.noaa.gov/seattle/

3. Estimating Available Supply

Assessment of total water supply availability should take into account availability of surface supplies and/or ground water supplies. List estimated water supply quantity and identify the source(s) of this information, including the water supply factor(s) used to determine this quantity and the agency, organization, or individual providing the information.

WORKSHEET 4
Available Supply

C. Supply and Demand Comparison

Once demand and supply information is developed, a determination of water shortage potential can be made. Compare estimated future supply and projected demand, and estimate the supply deficit (if any) that will occur over time under two scenarios:

1. A "most likely" scenario, which is the supply/demand situation you foresee as being the most likely to occur.
2. A reasonable "worst case" scenario, which is the worst supply or demand situation that could reasonably occur.

Identify the months, if any, during which a shortage is anticipated, and quantify the magnitude of the shortage to the extent possible.

WORKSHEET 5
Supply and Demand Comparison

Summary

By now, you should be able to identify your current consumption and projected demand. You should also be able to determine if you have a stable water supply or a trend toward decreasing supplies. By comparing demand and supply, you should be able to determine whether you are going to have a water shortage. Finally, by developing a "most likely" and a "worst case" scenario, you not only know which water supply situation is most likely to occur, but you are aware of the worst water supply situation that could reasonably occur in your service area.

Go to step 2.

Step Two: Options for Dealing with a Water Shortage

Objective

This step involves:

- Clarifying a utility's water resource policies.
- Reviewing and evaluating a variety of demand reduction and supply augmentation options.
- Selecting a course of action.

A financial program for implementing your chosen course of action will be developed in Step 3. At that time, you should review your course of action one more time to assure yourself that all of its elements can be paid for.

Options

In general, options for dealing with a water shortage fall into two categories:

1. Demand reduction
2. Augmentation of available supplies (*e.g.* more efficient utility operations, or new supply development through new wells or interties with other systems).

The questions that must be answered in this section are:

- How much of my potential deficit can I make up in demand reduction?
- How much should I make up by augmenting supplies?

How to combine demand reduction and supply augmentation is a decision best made by a utility because it is in the best position to gather and evaluate all of the information relevant to this choice. Although utilities establish WSRP priorities, the Office of Drinking Water recommends that water systems eliminate all wasted water. This involves activities such as leak detection and repair within distribution and transmission lines, as well as a public information campaign to encourage home leak repair and wise water use.

Plan Content

A. Utility Water Resource Policies

Before considering which options to choose, a utility should take this opportunity to examine its policies regarding long-term resource management, water shortages, conservation, water supply augmentation and rate adjustments. Clarification of policies at this time will facilitate the selection of a course of action. For example, if a utility has a policy of not raising water rates, not only will its funding sources for demand reduction or supply augmentation be more limited, it also will not be able to use rates as a demand reduction tool. Clarification of policies also enables a utility to eliminate inconsistencies. Again, use the policies set forth in your water system plan, if you have one.

Some questions a utility may consider in developing a clear set of water shortage-related policies are:

- Should short-term or long-term resource improvements be emphasized?
- Should demand reduction and supply augmentation receive equal consideration, or should one receive higher priority?
- Should growth be curtailed until a water shortage is over?
- Among the various classes of water users, who should bear most of the costs of demand reduction or supply augmentation? Should there be a balance?
- Are you willing to adjust rates to offset lost revenues due to demand reduction or to capital costs for supply augmentation?

Also, consider any opposition to your policies that might exist. How would your customers respond to rate adjustments? If one of your policies is to expand your water supply, consider and discuss whether this is realistic in light of possible environmental constraints and competing users of the water resource. Do you have adequate water rights for any planned increase in capacity?

WORKSHEET 6
Utility Policies

B. Demand Reduction Options

A utility should list all the possible demand reduction options it could reasonably carry out. To develop a comprehensive list of options, you may want to bring several utility staff and, perhaps, members of the interested public together for a "brainstorming" session.

Table I, on page 16, includes a list of demand-reduction options organized by type of action and the three stages of a water shortage: minor, moderate and severe (see discussion below). This list of options is not comprehensive. Demand reduction options can be added, deleted, or modified to fit a utility's unique circumstances.

Actions identified in Table 1 include:

A. Public information – Developing educational materials and activities on reducing water consumption.
B. Government – Identifying activities state and local government agencies (including public water utilities) could undertake to reduce water consumption, such as reduced irrigation of public parks and deferral of hydrant and main flushing. This also includes development and passage of any ordinances (laws) and regulations necessary to promote demand reduction.
C. User restrictions – Asking various utility customers to curtail or eliminate water use. This could include rationing. For example, restaurants may be asked not to serve water except upon request and residential customers may be asked not to wash their cars.
D. Penalties – Using fines or disconnection of service if customers do not adhere to certain conservation or rationing activities. Exercise caution when making a decision to disconnect service. Disconnection of service may result in direct and severe adverse

public health affects. The utility may be liable for unintended illness or injuries that result from the disconnection of service.

E. Pricing – Adjusting rates to encourage conservation (*e.g.* inclining block rate structures can be used), or using price incentives/disincentives while shortages are in effect (*e.g.* conservation surcharges coupled with rebates awarded to users that conserve the greatest percentage of water).

Stages of a Water Shortage

Selected demand reduction options should relate to the degree of water shortage that exists. For example, you would not want to impose water rationing upon your customers if you only had a 5 percent deficit in your normal water supply. Stages of a water shortage and corresponding demand reduction measures include:

Stage 1: Minor Shortage - Voluntary Measures This is the first step in reducing water consumption during a potential or actual water shortage. Based on experience in other states, a 5 to 10 percent reduction in consumption can be achieved with a voluntary program[2]. An appropriate response at this stage is to initiate a public information program.

Stage 2: Moderate Shortage – Mandatory Measures Based on the experience of utilities in other states, a 10 to 20 percent reduction in consumption can be achieved with a mandatory program.[2] An appropriate response at this stage is to institute mandatory demand reduction measures, enforceable under the authority of special ordinances, or a revised rate schedule.

Stage 3: Severe – Rationing Program Upwards of 30 percent savings can be achieved with a water-rationing program. An appropriate response at this stage is to institute rationing programs through fixed allotments or percentage cutbacks. This response should be initiated only in rare circumstances. It allows the maximum amount of water savings possible in a community without severe hardship. Again, this action would have to be enforceable under the authority of special ordinances.

A list of demand reduction options should be prepared based upon the examples provided in Table 1, and any additional demand reduction options you can think of. Estimate how much water each option is expected to save. Then place a 1, 2, or 3 next to each option, corresponding to one of the three water shortages above.

[2] Note that percent reductions cited in this document are based upon best information available in 1988, the date of original printing.

Table 1: Suggested Demand Reduction Actions

Stage	Water Shortage Condition	Consumption Reduction Goal (Percent)[3]	A. Public Information Actions
1	**Minor**: Voluntary Measures	5 – 10	• Prepare and distribute water conservation materials (bill insert, etc.). • Prepare and disseminate technical conservation information to specific customer types. • Prepare conservation retrofit kits. • Coordinate media outreach program. • Issue news releases to the media.
2	**Moderate**: Mandatory Program	10 – 20	• Distribute conservation retrofit kits. • Continue public information program.
3	**Severe**: Rationing Program	20 – 30	Continue public information program.

Stage	Water Shortage Condition	Consumption Reduction Goal (Percent)[3]	B. Government Actions
1	**Minor:** Voluntary Measures	5 – 10	• Increase enforcement of hydrant opening. • Increase meter reading efficiency and maintenance. • Promote intensive leak detection and repair program. • Draft and adopt ordinances[4] that: 1. Ban water waste. This ordinance could prohibit: - Unfixed leaks. - Hosing of paved surfaces. - Fountains that do not re-circulate water. - Water running onto streets. - Watering during the middle of the day. - Irrigation runoff. 2. Allow a utility to declare a water emergency and require rationing: - Fixed consumption allotments or percentage cutbacks (rationing). - Homes and businesses to have retrofitted showers and toilets.
2	**Moderate**: Mandatory Program	10 – 20	Reduce water usage for main flushing, street cleaning, public fountains and park irrigation. - Restrict watering of parks, cemeteries, etc., to nights or designated irrigation days.
3	**Severe**: Rationing Program	20 – 30	• Prohibit public water uses not required for health or safety unless using tank truck water supplies or reclaimed waste water. • Severely restrict irrigation at public parks, cemeteries, etc. • Pool covers required for all municipal pools. • Main flushing allowed only for emergency purposes. • Reduce system pressure to minimum permissible levels.

[3] Percent reductions cited in this document are based upon best information available in 1988, the date of original printing.
[4] Ordinances should be adopted for all activities requiring legal sanction or authorization. Determine which activities need such sanction or authorization and allow plenty of time to get your ordinance passed.

Table 1: Suggested Demand Reduction Actions (continued)

Stage	Water Shortage Condition	Consumption Reduction Goal (Percent)[5]	C. User Restrictions
1	**Minor**: Voluntary Measures	5 – 10	Implement voluntary water use reductions (see A.1 above).
2	**Moderate**: Mandatory Program	10 – 20	• Implement ordinance banning water waste (see B.1 above). • Adopt landscape irrigation restrictions that incorporate one or more of the following: - Time of day (*e.g.*, 7 p.m. to 7 a.m., etc.). - Weekly frequency (*e.g.*, odd/even, time per week, etc.). - Sprinkle bans (*e.g.*, hand). • Intensify voluntary reductions at commercial car washes. • Restrict golf course irrigation to 6 p.m. to 11 a.m. on designated days.
3	**Severe**: Rationing Program	20 – 30	• Implement ordinance allowing utilities to declare a water emergency and require rationing (see B.1 above). • Permit car washing only during specific hours on designated days. • Apply time-of-day restrictions to commercial car washes. • Reduce golf course watering times and weekly watering limits. • Manage water consumption to stay within allotments. • Reduce permissible hours and weekly frequency for landscape irrigation.

Stage	Water Shortage Condition	Consumption Reduction Goal (Percent)[6]	D. Penalties
1	**Minor**: Voluntary Measures	5 – 10	None.
2	**Moderate**: Mandatory Program	10 – 20	• Warning. • House call. • Shut off and reconnection fee.
3	**Severe**: Rationing Program	20 – 30	Fines.

[5] Note that percent reductions cited in this document are based upon best information available in 1988, the date of original printing.

[6] Note that percent reductions cited in this document are based upon best information available in 1988, the date of original printing.

Table 1: Suggested Demand Reduction Actions (continued)

Stage	Water Shortage Condition	Consumption Reduction Goal (Percent)[5]	E. Pricing
1	**Minor**: Voluntary Measures	5 – 10	None.
2	**Moderate**: Mandatory Program	10 – 20	• Institute rate changes to encourage conservation. • Impose surcharges.
3	**Severe**: Rationing Program	20 – 30	Same as above.

WORKSHEET 7
Demand Reduction Options

C. Triggering Criteria

It is very difficult to quantify shortages and to tell whether they are getting better or worse. The purpose of this exercise is to develop criteria that tell you generally if a shortage is getting better or worse. Think about how the stages relate to each other. How will you know when a water shortage is developing? List several factors that indicate a water shortage is on the way. Now list several factors that indicate a minor shortage is becoming moderate, and that a moderate shortage is becoming severe. These are called "triggering criteria."

To help you develop your criteria, consider the following factors:

- Static well-depth levels
- Well draw-down rates
- Water table levels
- Storage capacity levels
- River and stream levels
- Weather forecasts
- Precipitation records (rainfall and snowpack)
- Water quality
- Supply information from water wholesalers

Remember that forecasting the severity of a drought is an inexact science, even for the most sophisticated utilities. Often, decisions on the level of a demand reduction program to adopt must be made without the support of good technical water supply information.

WORKSHEET 8
Triggering Criteria

D. Supply Augmentation

A list and evaluation of supply augmentation options that a utility could undertake should be made. To assist utilities in developing their own list of supply augmentation options, a suggested list is in Table 2, on page 20. Again, this list is not complete. Utilities should add, delete or modify supply augmentation options to best accommodate their policies and circumstances. Sort supply augmentation options into the following categories:

- Improvements to increase existing supplies.
- Methods to increase efficiency.
- Comparative efforts with other utilities.

Estimate how much water each option is expected to provide.

Table 2: Suggested Supply Augmentation Improvements

Supply Augmentation	Example of Improvements
Improvements to increase existing supplies	– Reactivate abandoned wells.* – Rehabilitate operating wells. – Deepen wells. – Add new wells. – Increase surface water supply intake capability. – Develop new surface supplies. – Increase reservoir capacity. – Increase use of non-potable water for non-potable uses.* – Increase treatment plant capacity.
Methods to increase efficiency	– Service meters. – Source meters. – Use reservoir dead storage. – Suppress reservoir evaporation (use covers). – Reduce distribution system pressure. – Conduct a distribution system leak-detection and repair program. – Surge and clean wells. – Blend primary supply with water of lesser quality.* – Transfer surplus water to areas of deficit. – Change pattern of water storage and release operations.
Cooperative efforts with other utilities	– Interties. – Wheeling water arrangements. – Renegotiate contractually controlled supplies.

*Utilities should contact the appropriate DOH Regional Office (listed on pages 12 and 13) to evaluate the impact to water quality prior to initiating this action.

WORKSHEET 9
Supply Augmentation Options

E. Evaluating and Selecting a Course of Action

Different demand reduction and supply augmentation options require different levels of effort and expense. Ideally, to evaluate each of your selected options properly, consider how much water each is going to save or provide, and how much money each is going to cost. Select a final list of options by ranking all of your options by water saved and by cost. This allows you to eliminate the least "cost-effective" options; that is, the ones that cost the most while saving or providing the least amount of water.

Now, review and evaluate Worksheets 7 and 9. Based on your consideration of cost-effectiveness and consistency with your policies (Worksheet 6), select a final course of action.

WORKSHEET 10
Final Course of Action

Summary

By now, you have determined whether you have a shortage or a potential shortage. You have developed "most likely" and "worst case" scenarios that can help you meet various water shortage outcomes. You have developed utility policies regarding appropriate ways to address water shortages. You have also considered a wide variety of options, including demand reduction and supply augmentation options. Finally, you have selected a course of action tailored to your unique circumstances. You have just completed a major portion of your water Shortage Response Plan.

Go to step 3

Step Three: Plan Implementation

Objective

The objective of this step is to develop a program for putting your water shortage response plan into action. This step involves:

- Developing a schedule for carrying out your plan (unless it is a contingency plan).
- Determining how you are going to pay for it.
- Monitoring its effectiveness (*i.e.*, is your plan producing the desired results; do you need to do more or less?).

If you are developing a WSRP as a contingency plan, there is no need for you to develop a schedule at this time. However, a schedule should be developed two or three months before you decide to put your plan into effect.

Plan Content

A. Schedule

If you are facing a water shortage, or potential shortage, you need to develop a schedule for putting your plan into effect. For example, if one of your decisions is to develop a public information program, you may need to:

- Obtain or develop your own conservation brochures.
- Decide how you will distribute the brochures to your customers.
- Develop news releases.
- Decide if you will take your message to the schools.
- Decide if you want to obtain or develop conservation "retrofit kits." Such kits typically include flow restrictors for showers and faucets, displacement bags for toilet tanks, gauges for lawn watering, and leak detection tablets.

Allow ample lead-time for finding or developing suitable public information materials and for obtaining funding. Think through each of the activities you have decided to undertake. If developing a news release, how far in advance should it be provided to the news media? If distributing retrofit kits, how will distribution be handled? If printing conservation brochures, who will print them?

Your schedule should provide:

- Enough time to carry out your course of action.
- Monitoring of your water shortage at regular intervals in order to know whether to speed up or slow down any planned activities (use the triggering criteria developed in Worksheet 7).

WORKSHEET 11
Schedule

B. Financial Program

This is a very important part of your plan, as it largely determines whether your plan will become reality. This program consists of a budget for both:

- Demand reduction activities (if applicable).
- Supply augmentation activities (if applicable).

Budgets should include the total cost of each activity (that is, the cost of materials, labor, and overhead), and should identify the revenues that will pay for the activity (such as water rates, revenue bonds, loans, and/or grants).

You should also provide a discussion of:

- How lost revenues (if any) due to demand reduction will be accounted for.
- How rate adjustments (if any) will affect consumers and utility revenues.

WORKSHEET 12
Financial Program

C. Monitoring Program

The last step that needs to be incorporated into your plan is a monitoring program. You need to track existing or potential water shortages very closely, and develop a strategy for responding to changes in water supply outlooks. You also need to evaluate how well your WSRP is working. Is your plan working the way you intended? If not, what is the problem? What adjustments should be made? Determine how you will make this evaluation.

WORKSHEET 13
Monitoring Program

Summary

By now, you have developed a schedule and budget for putting your plan into action. You have also developed a strategy for monitoring your water shortage and the effectiveness of your plan once it is activated.

By following each of the three steps in these guidelines, you now have a well-conceived plan. You may never have to put this plan into effect. However, having this plan ready to implement provides you with the security of knowing that you are well prepared to handle a potential water shortage.

Worksheets

Worksheet 1 – Current Water Consumption

Month Consumption Category												
Source Meter Reading or Estimated Consumption												
Total No. of Gallons Consumed Each Month												
Average No. of Gallons Consumed Each Day												
Estimated Peak Day Amount (2 x Avg. day use)												

Worksheet 2 – Water Demand Factors

Provide a brief discussion of the following factors:

1. User characteristics. (What percentages of residential, commercial, industrial, and agricultural users make up your customer population?)

2. Population and growth forecasts

3. Drought impact on consumption

4. Other factors

Worksheet 3 – Water Demand Projections

Month Demand Projections												Total Demand
Average Day Demand												
Peak Day Demand (2 x Avg. day demand)												

Worksheet 4 – Available Supply

Summarize available information on each water supply factor relevant to your utility:

Surface Supplies

1. River and Stream Flows

2. Reservoir Levels

3. Lake Levels

4. Snow Pack

5. Other

Ground Water Supplies

1. Static Well Levels

2. Pumping Water Levels

3. Soil Moisture

4. Ground Water Table Elevations

Worksheet 4 (Continued)

5. Other

Other Supply Factors

1. Precipitation Records and Forecasts

2. Long-Term Weather Forecasts

3. Water Quality

4. Supply Status and Forecast Information from Water Wholesalers

5. Water Rights

6. Other

Worksheet 5 – Demand and Supply Comparison Summary

Based on water demand and supply projections, summarize your potential for water shortages. Quantify the deficit (if any) as best as possible. Include realistic water shortage scenarios.

Worksheet 6 – Major Utility Water Resources Policies

Itemize and discuss any water resource policies you may have.

1.

2.

3.

4.

5.

Worksheet 7 – Demand Reduction Options

List and provide a brief description of as many demand reduction options that your utility possibly could use (column A). Estimate how much water each option is expected to save (Column B). Then place a 1, 2 or 3 next to each option, corresponding to the water shortage stage in which it should be implemented.

Minor shortage = 1
Moderate shortage = 2
Sever shortage = 3

A. Demand Reduction Option	B. Water Saved (Est. Percentage or Quantity)	C. Water Shortage Stage

Worksheet 8 – Triggering Criteria

List criteria that will be used to initiate your WSRP and to determine when each stage of your demand reduction program will be implemented.

A. WSRP Initiation Criteria

B. Stage Criteria

Worksheet 9 – Supply Augmentation Options

List supply augmentation options that could be constructed or accomplished by your utility (Column A). Indicate how much additional water supply each option will provide (Column B).

A. Supply Augmentation Option	B. Additional Water Provided

Worksheet 10 – Final Course of Action

Determine a final course of action based on the preliminary demand reduction and supply augmentation options identified in Worksheets 7 and 9. A thorough evaluation of each potential option should be conducted prior to making the final selection.

A. DEMAND REDUCTION OPTIONS

Stage	Drought Emergency Condition	Demand reduction Goal (percent)	Public Information Actions	Government Actions	User Restrictions	Penalties	Pricing
1	Minor	5 – 10					
2	Moderate	10 – 20					
3	Severe	20 – 30					

Worksheet 10 – Final Course of Action (Continued)

B. Supply Augmentation Options

1. Improvements to increase existing supplies

2. Methods to increase efficiency

3. Cooperative efforts with other utilities

Worksheet 11 – Schedule

Month Program Elements												Total Demand
A. Demand reduction Options												
B. Supply Augmentation Options												

Worksheet 12 – Financial Program

A. For each demand reduction and supply augmentation activity, action or improvement identified on your schedule, indicate the cost and how it will be financed.

Activity, Action or Improvement	Cost	Payment Plan
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

B. Summarize how lost revenue will be accounted for if consumption is reduced through implementation of a demand reduction program.

C. Summarize how rate adjustments will affect consumers and utility revenues.

Worksheet 13 – Water Shortage Monitoring Program

Summarize how you will track existing and potential water shortages. A clear strategy for responding to changes in water supply outlook should be identified. Refer to Worksheet 8 – Triggering Criteria.